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semi-circular course, but southward to the Chulitna River. Between these two glaciers there is a wide belt of sharp mountains from five thousand to twelve thousand feet high, separated by deep cañons.

Mount McKinley offers a unique challenge to mountaineers, but its ascent will prove a tremendous task. It is the loftiest mountain in North America, the steepest mountain in the world, and the most frigid of all great mountains. Its slopes are weighted down with all the snow and ice that can possibly find a resting-place, but, unlike Mount St. Elias, the glaciation is not such as to offer a route over continuous ice. Every conceivable way is interrupted by overhanging glaciers of granite cliffs. The area of this mountain is far inland, in the heart of a most difficult and trackless country, making the transportation of men and supplies a very arduous task. The thick underbrush, the endless marshes, and the myriads of vicious mosquitoes bring to the traveller the troubles of the tropics; the necessity of fording and swimming icy streams, the almost perpetual cold rains, the camps in high altitudes on glaciers, in snows and violent storms, bring to the traveller all of the discomforts of the Arctic explorer; the very difficult slopes, combined with high altitude effects, add the troubles of the worst Alpine climbs. The prospective conqueror of America's culminating peak will be amply rewarded, but he must be prepared to withstand the tortures of the torrids, the discomforts of the North Pole seeker, combined with the hardships of the Matterhorn ascents multiplied many times.

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## SOUTHERN RUSSIA AND THE CAUCASUS MOUNTAINS.\*

BY

EDMUND OTIS HOVEY.

Once in three years the geologists of the world meet to discuss questions of their science which concern all countries alike. These congresses began with one held in Paris in the year 1878 as the fulfillment of a plan proposed at the meeting of the American Association for the Advancement of Science at Buffalo, New York, in 1876. Other meetings of the Congress have been held in Bologna,

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\* Synopsis of a lecture delivered before the American Geographical Society, Tuesday, 19 April, 1904.

1881; Berlin, 1885; London, 1888; Washington, 1891, and Zürich, 1894. The seventh Congress was held at St. Petersburg in August, 1897, and was the occasion which enabled the speaker,\* in company with many associates, to make an extended tour in Russia under exceptionally favourable circumstances. One of the most attractive and instructive features of each congress has been the excursions which have been offered before, during, and after the business sessions, for the purpose of affording visiting geologists an opportunity for getting a comprehensive view of the geology of the country in which the meeting is held. When it was known that the Congress was to meet in Russia, the first question which arose was, What will the Russians do to show us their mines and their geology? Most royally did the Tsar and his subjects reply to the query.

Custom-house and passport regulations were mollified for the benefit of members, and free passes calling for first-class transportation over all the railroads of the empire, for nearly four months, were enclosed with the certificates of membership. The geological excursions before the sessions offered opportunities for different parties to visit Finland, Esthonia, and the Ural Mountains; while afterwards the "Congressists" had the choice among routes covering all the most interesting portions of southern Russia in Europe—the Crimea, the Caucasus, Baku, and Transcaucasia, as far south as Mount Ararat, in Armenia, on the boundary line between Russia, Persia, and Turkey. With such an array of attractions in a country the interior of which is usually so difficult of access to the tourists it is small wonder that geologists all over the world turned their faces toward Russia in the summer of 1897, until the seventh International Geological Congress surpassed all its predecessors in point of attendance. After the Congress the unanimous feeling of the members in attendance was that every Russian, from the Tsar to the humblest peasant, had put forth his utmost effort to make the visitors welcome and to provide for their comfort and convenience. The American contingent, in particular, was most cordially received everywhere.

Russian national life may be said to have had its beginning during the fifth century of the Christian era at two centres—Kief, on the Dnieper River, and Novgorod the Great, on the Ilmen. Nine hundred years later Moscow became pre-eminent, and from the kingdom of Muscovy the Russians began to push out in all directions. They suffered many reverses from their hostile neigh-

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\* As the official delegate of the American Museum of Natural History.

bours, and for generations paid tribute to the Tartars who overran their country from the east. Not until the middle of the sixteenth century, under Ivan the Terrible, did Russia achieve entire independence of the Tartar hordes. Succeeding monarchs were busy consolidating their country, and incidentally adding to its territories by absorbing contiguous lands, but the idea of expansion by absorption did not take complete possession of rulers or people until the close of the seventeenth century, when Peter the Great ascended the throne.

From the reign of this remarkable Tsar onward the world has seen a wonderful development in the general civilization of Russia, and a continuity of purpose in the absorption of territory towards the east and southeast, until the undisputed sway of the Great White Tsar extends from Mount Ararat on the south to the Arctic Ocean, and from the Baltic Sea on the west to the Pacific. We have seen Merv, Samarkand, Tashkent, and the warlike provinces extending along the western slopes of the Tian Shan Mountains become peaceful dependencies of St. Petersburg. It remains to be seen whether the present war with Japan will force Russia to loose her hold upon the rich province of Manchuria and abandon this much-needed outlet from Siberia to the Pacific Ocean. It is not my purpose, however, to discuss Russian history and diplomacy in the Far East. I propose to confine myself to some of the features of southern Russia-in-Europe, the Caucasus, and Trans-Caucasus, drawing my material, for the most part, from my own observations and experiences in connection with some of the excursions succeeding the stated sessions of the already mentioned International Geological Congress.

Russia proper occupies most of the vast saucer which forms two-thirds of the continent of Europe. The rim of this saucer is indicated by the Ural Mountains on the east, the Caucasus and Carpathian Mountains on the south and southwest, and the Scandinavian Mountains towards the northwest. European Russia, which is two-thirds as large as the United States, supports a population one-half again as great as our own. Soil and climate, and the resulting industrial development of the people, vary greatly in the different parts of the country. In southern Russia one finds extensive flat lands stretching northward from the Black Sea and the Sea of Azov; towards the east these plains slope gently towards the Caspian, where they become desert areas.

The plains of the central and southwestern portion of the country are fertile, and raise more than enough grain for the consump-

tion of the inhabitants; but the basin of the Donetz River is of supreme importance, on account of the mineral wealth therein contained. Here occur the only workable beds of coal in European Russia. Most of this valuable mineral is exploited by foreign companies working under Imperial concessions. Quicksilver is found here in quantities which make Russia the fourth in rank of countries producing that metal. The only mine, however, in operation is that of the English firm of A. Auerbach and Company, which is at Nikitovka, in the province of Ekaterinoslav. At Dekonskaïa, near Bakhmut, extensive salt deposits of Permian Age are in process of exploitation. One of the mines has its principal galleries in a bed of solid rock salt 117 feet in thickness, the bottom of which is 422 feet below the surface of the ground. In this mine there are 326 feet of granular and crystalline pure rock salt in seven beds between 305 and 764 feet underground. In 1896 the salt mines of the Bakhmut region had a production of 288,240 tons per annum, and were still increasing their output.

On leaving the Donetz basin, one traverses the vast flat plains left by the retreating Sea of Azov, and after a long, uninteresting ride is glad to see the snow-capped peaks of the Caucasus gradually approach. The Caucasus Mountains extend in almost unbroken line from the northwest to southeast, attaining an elevation considerably above that of the Alps; while several of the individual mountains, such as Elbruz, Koshtantau, Dykhtau, and Kazbek, rise far above the altitude of Mont Blanc.

The chief mineral spring area of Russia—what one may call the Saratoga of the country—centres about Piatigorsk and Kislovodsk, north of Mount Elbruz, and the region is much frequented for inward and outward application of the waters. In several districts here one finds ferruginous, alkaline, and acidulated carbonic springs which may be regarded as the final phase of once extensive volcanic activity.

Mount Elbruz, which is visible as a cloud upon the horizon during the latter part of the journey across the low plains bordering the Sea of Azov, is not in sight from the mineral water region; but a day's horseback ride through the mountains of Kislovodsk brings one to Mt. Bermamut, from which is obtained a famous view of the mountain. Mount Elbruz, the loftiest peak in Europe, 18,466 feet (5,630 m.) in height (Stieler), is an ancient volcano terminating in two peaks, in each of which there is a crater.

Koshtantau, 17,092 feet (5,211 m.), Dykhtau, 16,895 feet (5,151 m.), and other giants rise from the more ancient rocks of

the central Caucasus. Many glaciers are to be found in this area, the most noteworthy of which, perhaps, are the Karagom and the Bezingi. The Caucasus Mountains long formed a practically impassable barrier to advance by land from Asia into Europe. The northern ranges of the mountain system have a more gentle inclination toward the north than they have toward the south; while the contrary is true of the southern ranges. The general slope of the system as a whole, north of the watershed, is steeper than that of the portion south of the crest. The watershed forming the boundary between Europe and Asia is sometimes a narrow or even sharp ridge, and at other times a more or less extensive plain, which, in places, is swampy. The principal geological researches upon the great complex, which, indeed, extends as far south as Erivan, have been made by Abich, Favre, Sorokin, Simonovitch, Karakasch, Inostranzeff, Fournier, and Loewinson-Lessing\*; while the English mountaineer Freshfield has given us, in his work "*The Exploration of the Caucasus*," the best and most comprehensive popular description of the region.

Abich considered the whole Caucasus system as an enormous anticlinal, overthrown toward the north, but the investigations of the later workers have modified this simple conception in great degree. Palæozoic and Liassic schists constitute the fundamental great anticlinal. This has been overthrown and compressed. It includes the granitic central massif, together with the gneisses and mica schists, and a whole system of beds and dikes of diabase, porphyrite, and diorite. The whole is pierced and covered with enormous beds of recent andesitic lavas and with volcanoes more or less well preserved. Somewhat strikingly-marked unconformities exist between the Lias and the Upper Jurassic, between the latter and the Cretaceous, and between the Cretaceous and the Tertiary strata. In general, all the beds dip toward the north-northwest or the north-northeast; but they are not isoclinal, inasmuch as the angles of dip vary.

In addition to the principal anticlinal, there are several minor folds on both slopes of the system; and the rocks indicate that there have been two directions of orogenic movement—the more ancient toward the north-northwest, and the more recent toward the north-northeast. The several minor longitudinal valleys of the

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\* The last-named author has given in the "*Guide des Excursions du VII Cong. Géol. International*," Part XXII, a summary account of the central Caucasus Mountains, and the Georgian Military Road in particular, which has been freely consulted in the preparation of these pages.

northern slope are developments along broken-down anticlinal axes. The elevation of the chain began after Liassic time, and orogenic movements took place in the Jurassic, in the Cretaceous, and in the Miocene. That the several movements have not ceased is shown by the occurrence of frequent earthquake shocks over large areas.

The ethnography of the Caucasus presents a diversity which is full of interest, and which has not been completely deciphered. It has been contended that the skulls found at Mtskheta, Delijan, and elsewhere indicate that the ancient population of the Caucasus was of dolichocephalic development, although the present native inhabitants belong to the brachycephalic type.

One finds in the region an almost endless array of languages and dialects, since this seems to have been a general clearing-house for the wandering peoples of Europe and Asia. Christians, Mussulmans and pagans, Aryans, Semites and Mongolians, are to be found here in greater or less degree, presenting a wonderful variety of culture and speaking many diverse tongues. Although the languages of the Caucasus are not as yet entirely investigated, they may be grouped as follows (Loewinson-Lessing):

Ural-Altai,

Aryan,

Kartvelien or Iberian (which is the Caucasus group properly so-called),

The Western Mountain,

The Eastern Mountain.

Aside from the Russians and from the colony of Germans located near Tiflis, one encounters in traversing the Georgian Military Road at least eight tribes:

The Cossacks of the Terek (Russians and Little Russians),

The Osses or Ossetes (Christians and Mussulmans),

The Inguches, who are relatives of the Tscherkesses Adighe (Mussulmans),

The Georgians or Kartveliëns (Christians),

The Mokheviëns (Georgians),

The Pchaves (Georgians),

The Khevsurs (a mountain tribe of pseudo-Christian character speaking the Georgian language),

The Armenians.

From Vladikavkaz to Kobi, the Georgian Military Road, which is practically the only route across the mountains, follows the valley of the Terek, piercing the lateral chain for a distance of seven and

one-half miles by the famous Dariel (or Darial) gorge. At Kobi the route leaves the valley of the Térék, ascends the gorge of the Baidarka, traverses the Krestovaïa Gora, or Pass of the Cross, 8,015 feet (2,443 m.), and descends rapidly to Mléty, a little hamlet situated upon the banks of the White Aragva. From Mléty the route continues along the White Aragva as far as Ananur, where it leaves the stream-bed and climbs the heights of Duchet. Before Tsilkani is reached the road comes down again to the river, which has now become a large stream through the influx of the Black Aragva. From this point the valley widens and the road advances by easy grades to Mtzkhet at the junction of the Aragva with the Kura, where it crosses the latter stream and follows its right bank down to Tiflis. Different points along the route and in its vicinity have been celebrated in Russian poetry and song, particularly by Puschkin and Lermontoff.

The supposition that the Dariel gorge served for the passage of ancient Asiatic peoples coming to overwhelm Europe seems to be without sufficient foundation. From time immemorial this has been the route of the mountain tribes which periodically overran Georgia, and which completely dominated the defile before the establishment of the Russian power. According to the Georgian chroniclers, the first forts of the Dariel were located in the second century after Christ, and the bold cliffs of the gorge have witnessed a long succession of wars, battles, and massacres. The route was known in very ancient times, if we are to believe those who recognize in this pass the "Porta Caspiæ" described by Procopius, the author of the history of the wars waged by the Romans against the Persians. There seems to be no doubt that the "Porta Caucasæ" of Iberia, mentioned by Pliny in his "*Historia Naturalis*," was the Dariel gorge.

In the Georgian chronicles several different names are applied to the gorge in question, but it is most frequently called the Dariel or Darial—a name which is thought to have had its origin in the Persian "dar" or "der," which signifies "gate" or "door." Dar-i-Allan would mean the Allan Gate, or the Gate of the Allans. The first Russian troops to pass through the gorge were sent in 1769 to defend Georgia against the Turks. The first bridges over the Térék were built in 1809. The region was given over to Russia by Turkey by the Treaty of Adrianople in 1829, but the last independent mountain tribe did not surrender to the forces of the Tsar until 1864. The thirty-five years during which the struggle for the Caucasus continued witnessed many prodigies of



valour by the invading Cossacks and by the brave defenders of home and liberty in the mountains. The name of the Mohammedan leader Schamyl will be immortal in the annals of the wild tribes of Daghestan for the success with which he waged the unequal contest against Russia for thirty years.

Along the Georgian Military Road the most prominent mountain is that known to the civilized world as Kazbek—a name which was applied to the peak at the beginning of the nineteenth century by the Russians themselves in honour of the chief or “moourave” Kazbek, who lived in the village of Stepan-Tzminda, and served as an intermediary between Russia and Georgia before its annexation. The Georgian name for the mountain is Mkinvari (snowy or icy), or Kirvan-Tservi. The Ossetes use the names Urs-Goh (the White Mountain), Chresté-Tsub (the Mountain of Christ), and others. The native inhabitants consider the peak of Kazbek to be entirely inaccessible—an opinion from which they cannot be dissuaded. The first attempt to ascend the mountain was made by Parrot in 1811; the second by Colenati in 1844. Success was reserved for Freshfield, Moore, and Tucker, who, in 1868, were the first to set foot upon the actual summit, which is 16,541 feet (5,043 m.) above the level of the Black Sea. About twenty years later a successful ascent was made by the Russian topographer Pas-tukhoff.

The Greek poet Æschylus is supposed to refer to some of the cliffs of Kazbek in his tragedy “Prometheus Bound,” and many other legendary and historical associations cluster about the forbidding defiles of the great mountain mass. Opposite the station of Kazbek and the glacier Orotsveri is the ancient church Tzminda-Sameb, which was once, perhaps, a monastery. Popular tradition assigns the construction of this church to Queen Tamara, a favourite sovereign of the Georgians, who reigned in the eleventh century. Between the Abanot and Orotsveri glaciers there may be seen, at an altitude of about 11,500 feet above the sea, the remains of ruins, which seem to confirm the popular legend of an inaccessible cloister called Bétlem, containing wonderful riches.

Caverns, too, are known in the sides of the mountain, some of which have served as habitations for anchorites. One of the caverns, whose exact position can be known only to the very elect, is thought by the natives to contain the tent of Abraham and the cradle of Christ. Between Balta and Lars are the ruins of several ancient forts; while in the Dariel Gorge one may see the ruins of a castle ascribed to Queen Tamara.

The pass itself is known as the Krestovaia-Gora, or Mount of the Cross, on account of a stone cross which was erected in 1824 to designate the summit of the pass, which is the watershed between Europe and Asia. The cross stands three hundred yards east of the road, on the spot formerly occupied by the cross said to have been placed there eight hundred years ago by the same Tamara.

Mtzhket is considered by its native inhabitants to be the oldest city in the world. According to tradition, it was founded by Mtzhketos, the son of Kartlos, who was of the fifth generation after Noah, and was the originator of the Georgian people. The city was the capital of Georgia until 469 A.D., when the seat of government was transferred to Tiflis. The principal building in Mtzhket is the Byzantine cathedral, built early in the fifteenth century by Alexander upon the site of the church which had been erected 1,100 years before by King Miriam. Miriam's church was destroyed by Tamerlane during his invasion of Georgia, and the present is the fourth edifice which has occupied the place. North of the cathedral there were discovered, in 1871, tombs arranged in two stories, one above the other. The lower range contained objects of the Iron Age belonging to the tenth or eleventh century before the Christian era. Those of the upper range contained Roman money of the time of the Emperor Augustus. The skulls found in the tombs were dolichocephalic in type. Many valuable archæological relics have been found throughout the Caucasus region, and a large collection of such objects is preserved at the Ethnographic Museum in Tiflis.

In early historic times the great plain lying between the Caucasus and the Anti-Caucasus mountains was divided among three kingdoms: Colchis in the west, bordering on the Black Sea; Albania in the east, bordering on the Caspian Sea; and Iberia in the middle. Of these, Iberia was by far the most powerful, since she had the most fertile land, and had control of the only practicable route northward across the Caucasus Mountains, and of the best one southward toward Persia.

The people of the middle kingdom successfully withstood the onslaughts of the Medes and the Persians, but succumbed to the armies of Rome under Pompey, and from his time remained a part of the Roman empire until its dissolution. After the division of the empire, Iberia was long a scene of contest between the Eastern Empire and the Persians. In the eighth century the dynasty of the Bagratidæ ascended the throne of the country, which had now

come to be known as Georgia, and maintained itself until the end of the eighteenth century, when Heraclius placed his country under the protection of Russia, to prevent its falling before a powerful Persian force. In 1801, George XIII abdicated in favour of Tsar Alexander I, and Georgia became a part of the Russian empire.

Tiflis, now a city of more than ninety thousand inhabitants, was the capital of the kingdom of Georgia from the year 469 onward, and has been the capital of the province of Trans-Caucasia since Russian domination began. The city is picturesquely situated on both sides of the River Kura, and is divided into three sections. The Georgian quarter, on the left bank of the tumultuous stream, is characterized by dirt and lack of thrift; the Persian and Armenian quarter is on the right bank, and is a busy hive of industry, which leaves much to be desired, however, in the way of cleanliness; the modern Russian quarter lies on the high ground forming the second terrace of the Kura on the south side of the river, and is cleanly and attractive in appearance. The cosmopolitan character of Tiflis is indicated by the fact that seventy languages may be heard spoken in its streets (Brugsch). At present Tiflis is not a fortified town, although extensive arsenals and barracks have been established in the northern part of the city.

On a high ridge rising abruptly from the right bank of the river are the ruins of the ancient fortress which protected the city when it was the capital of Georgia. The portion of the city which arouses the most interest in the foreign visitors is the so-called "Bazaar" of the Persian-Armenian quarter. Here the streets are distressingly narrow, and crooked little lanes and byways ramify in all directions among the low wooden houses. The main specialty of the artisans is the decoration of silver with a kind of black enamel in intricate designs. Everything is done by hand with the simplest tools imaginable. The forge is a portable affair, made from a single block of stone, with a shallow depression in the top to hold the coals and a hole drilled in the bottom thereof downward to connect with the pipe from the bellows. The latter contrivance is merely a bag of soft goat's skin, which opens at the top like an ordinary traveller's handbag. The forge-tender is a boy, who dexterously opens the bellows and fills it with air with one upward motion of his hand and then closes it and forces the contained air into the fire of the forge with a single downward motion. A considerable portion of two streets in the "Bazaar" is devoted to the shops of the silversmiths, and one can see sword and dagger

scabbards and handles, cups, thimbles, cuff-buttons, brooches, and many other articles of adornment or utility in all stages of manufacture.

The western kingdom, the ancient Colchis, lies upon the Black Sea slopes of the transverse ridge which connects the Caucasus with the Anti-Caucasus Mountains. This transverse ridge or range, which is known as the Suram Mountains, consists of granitic rocks, and nowhere is more than 3,000 feet in elevation above the sea. Its crest forms the watershed between the Rion River on the west and the Kura River on the east. The chief city of Colchis was Cotatis—a name which the vicissitudes of time have changed to Kutaïs. Hither in mythological times came Jason and his crew of Argonauts in quest of the Golden Fleece. An explanation of this legend, which has long been current, is that the fleece received its name from having been spread on the bottom of the river to catch the tiny particles of gold brought down by the stream from the mountains. Similar processes of winning gold are known in many places; but little, if any, gold is now known to occur in the bed of the Rion River, which is the River Phasis of the ancient Greeks and the Argonautic expedition.

Kutaïs is now an important place of about 23,000 inhabitants, and is a good starting-point for expeditions into the western Caucasus. The high valleys of this part of the Caucasus system are broader and more fertile than those of the northern slopes. This has tended toward a greater feeling of independence on the part of the tribes inhabiting them—a fact that is strikingly illustrated in the case of the Svanetians, who pay but weak allegiance to the Russian power.

At Tkivuli, a few miles up the valley from Kutaïs, occur the only coal mines that have been opened in the Caucasus region. The coal-bearing beds are of Jurassic Age, and the coal is not of as good quality as is that which is produced in the Donetz basin. It is of the lignite type, and is pressed into briquettes for distribution and use. Not far from Kutaïs occur important beds of manganese ore. Time and space do not permit further discussion of the interesting environs of Kutaïs and the archaic customs of the inhabitants; the architecturally perfect monastery of Ghelati; the ancient ruins of the little village of Suram, on the cross range already mentioned; of Borjom, one of the favourite resorts of the Russian nobility, and of other places of more or less historic interest or beauty, or of peculiar physiographic development in this great region.

At the extreme southeastern end of the Caucasus Mountains, upon the southern slopes of the peninsula of Apsheron, 345 miles east of Tiflis, lies Baku, which is the ancient Getara. This was the chief city of the old kingdom of Albania, and was for a long time included in Persia, though it has now been a Russian city for more than three-quarters of a century. Baku is by far the most important place on the Caspian Sea, from a commercial point of view; but its chief interest to the world outside of Russia lies in the fact that it is so near the greatest petroleum region in the world. Up to thirty years ago the city scarcely exceeded twenty-seven thousand in population; but from the time that the Nobel Brothers secured the imperial concessions which enabled them to consolidate the oil business of the region the city has seen a marvellous growth, and in 1896 its population was 115,000.

The peninsula of Apsheron is underlain by oil-bearing strata of Tertiary Age. According to A. Konchin,\* the geological section of the peninsula is, in descending order:

I.—The Post-Tertiary deposits of the Caspian Sea: Loess, clays, gravel, conglomerate, and shell-bearing littoral deposits, all mingled with ejections of mud and oxidized petroleum products from the ancient and modern mud volcanoes.

II.—Deposits of Tertiary Age:

(3) Shale, limestones, sands, clays, and sandstone of the Upper Aralo-Caspian (Neocene).

(2) Oil-bearing sands (with or without water), sandstones, and clays of the Oligocene.

(1) Marls and shales, containing fish remains of the Upper Eocene.

The oil-bearing Oligocene sands and sandstones are associated with clays and marls of the same age, which likewise contain some petroleum, but in too small amounts for productive exploitation. The Oligocene beds form a gentle anticline, the axis of which is inclined at a low angle from the northwest toward the southeast. The oil-bearing strata are nearest the surface at Balakhany, about eight miles north of Baku, where the total thickness of the petro-liferous beds is from 350 to 870 feet. This thickness increases to 1,750 feet at Ramany and Sabountchy, two miles southeast of Balakhany.

The productive beds are separated from one another by layers

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\* "Guide des Excursions du VII Congrès Géologique International," XXIV.

of clay, which are impermeable to both gas and oil. Consequently, the wells are sunk from one stratum to another as fast as the pressure in the upper beds lessens and the supply of oil diminishes. The wells in the Balakhany-Sabountchy district vary from 500 to 1,500 feet in depth. The total area of this remarkable oil field is scarcely more than six square miles.

About three and one-half miles south of Baku there is a small oil field, known as Bibi-Eibat, the character and structure of which are exactly like that of the one already mentioned, but the productive beds lie nearer the surface. From these two contracted areas 80,540,045 barrels of crude oil were produced in 1902, which was almost as much as was produced in the whole of the United States. The value of the Russian oil, however, is much less than that produced in the United States, because it lacks the paraffin and other valuable by-products which characterize the oils from the Appalachian, Ohio, and Indiana fields. Owing to various causes the production for 1903 in the Baku fields decreased by 7% from that for 1902. Spouting wells are a picturesque characteristic of the Apsheron oil fields, about 23% of the oil coming to the surface in this manner. The inspection of the great refineries of the Nobel Brothers, the Rothschilds, and others is an interesting feature of a visit to Baku and its vicinity.

The region of the oil fields contains many vents, from which natural gas issues with more or less force. Near Bibi-Eibat the gas comes up through the waters of the Caspian Sea, and a picturesque effect is produced at night by igniting the bubbles as they rise. Near Balakhany the gas throws up water and mud, and has formed the mud volcano known as Bog-Boga. At Surakhany, south-east of Balakhany and just beyond the edge of the productive oil field, natural gas has issued from the ground copiously for centuries; and here are to be seen the abandoned temples of the Parsi Fire-Worshippers—since this was the centre of that cult—and the objective point of countless pilgrimages from Persia to the shrines of the eternal fires. Not until 1880 did this worship cease, when, by the order of the Tsar, the last degraded priests were expelled from the country. Now the gas issuing from the ground is piped to the neighbouring village and put to practical use for heat and light. The contest between Oriental mysticism and the practical ideas of the Western civilization has resulted in the exclusion of the former and the exploitation of the resources of nature for the benefit of mankind.

The journey southward from the valley of the Kura across the

Anti-Caucasus range of mountains presents many features of the greatest interest on account of their contrast to the mountains of the main Caucasus range. Now there is a railroad southward from Tiflis to Alexandropol and Kars; but the old post-road from Akstafa, a little station sixty miles east of Tiflis, presents much of scenic and geologic interest, and was the route followed by the author when he visited Mount Ararat.

From Akstafa the post-road crosses the "Long Valley" of the Kura and ascends the winding valley of the Akstafa River as far as Delijan. After leaving the Quaternary deposits of the immediate Kura valley white and blackish limestones of late Cretaceous Age are encountered, which dip gently toward the northeast. Twelve miles from the plain of the Kura these limestones show insignificant folds for a half-mile and then take a definite inclination toward the south. Piercing the limestones, and associated with them, there are eruptive rocks of rather basic character, while some of the limestone beds rest upon deposits of volcanic tuff.

At Delijan, fifty miles from Akstafa, the road to Erivan leaves the bed of the river to cross the pass of Tchibukhly (7,421 feet). To the east lies the rugged Karabagh country, where brigandage is still rife. To the west is the somewhat more peaceful valley of ancient Georgia. The pass is broad and undulating, and slopes gently toward the south, where the road soon comes out upon the shores of the beautiful Lake Goktchaï, or Sévanga (called Lychnitis in ancient writings), which it follows as far as the village of Jélénovka. This lake, which is fifty miles long and twenty-four miles wide, is one of the loftiest bodies of water in the world, its surface being 6,340 feet above the sea. The lake is remarkable for its periodic variations in altitude, and is noted for the beauty of scenery, due to the surrounding ancient volcanoes and the promontories of volcanic rock projecting into it.

From this point onward the route traverses the elevated volcanic plateau of Armenia. The general view of the plateau, with its numerous volcanoes, which is obtained just as the road begins to descend into the valley of the Araxes River, is impressive. Toward the west the view is bounded by the colossal Alagheuz (14,279 feet), on the east by Agdagh (10,758 feet), and Agmangan (11,897 feet), while on the south lie the incomparable mountains of Ararat, culminating in the great Ararat itself, more than sixty miles away.

Armenia, like Poland, has had a checkered history, which has resulted in her partition among three more powerful neighbours.

In 1828 the treaty of Turkmanchai secured the northeastern part of the kingdom, with the capital, Erivan, to Russia. The remainder of the country had already been divided between Persia and Turkey. Erivan, now the seat of government of the Russian province of Armenia, is interesting on account of its industries and the remains of ancient grandeur.

Mount Ararat is the result of complex volcanic activity dating from the Cretaceous and Tertiary times, which ended in the production of the Great Ararat, now 17,092 feet in altitude, and the Little Ararat, 12,989 feet. The peaks are about seven miles apart as the crow flies. Eruptions ceased so long ago that the semblance of a summit crater has been almost entirely removed from the Little Ararat; while the upper four thousand feet of the Great Ararat are covered with eternal snow, concealing any evidence that there might otherwise be of ancient craters. The lavas of the Ararats belong to the rocks known as andesites—a class of medium acidity.

Rising as these mountains do in an isolated position from a plain scarcely three thousand feet above the sea, the grandeur due to their altitude has its full effect. They dominate the region for scores of miles in every direction, and when one views them in the light of the rising or the setting sun, under the glare of mid-day or by the light of the full moon, he does not wonder at the numerous legends which have grown up during the centuries in the minds of the shepherd tribes which inhabit the country.

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#### NOTES ON THE U. S. GEOLOGICAL SURVEY.

TWENTY-FOURTH ANNUAL REPORT, 302 PP., 1902-1903.—The prompt issue of this report adds to its interest and value. The great additions to resources for the reclamation of the arid lands and for general hydrography receive suitable attention, a hydrographic branch having been organized under the direction of Mr. F. H. Newell. The appropriation for the year was \$1,377,470. Investigations in Alaska are noticed with fulness commensurate with recent expansion of work in that field.

In the topographic branch co-operation was effected with twelve States, New York leading in the appropriations with the sum of \$22,000, and 31,000 square miles, or nearly two-thirds of the State, had been covered to April 30, 1903. The report contains